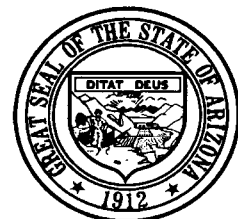


# **II**

## *Regulatory Programs*

- Chapter 4      Agricultural Conservation Program
- Chapter 5      Municipal Conservation Program
- Chapter 6      Industrial Conservation Program
- Chapter 7      Groundwater Quality Management Program
- Chapter 8      Augmentation and Recharge Program
- Chapter 9      Water Management Assistance Program
- Chapter 10     Plan Implementation



# Preface

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Section I provided an overview of the Arizona Department of Water Resources' (Department) statutory authority and management objectives, and described the physical, climatic, demographic, and water use characteristics of the active management area (AMA). Long-term water level declines, land subsidence, and water quality problems, coupled with current and projected groundwater over-drafting estimates, provide compelling justification for the development of progressive and responsible water management programs.

This section of the Third Management Plan is entitled "Regulatory Programs" because the programs described are required of groundwater users or are preconditions to obtaining certain permits or financial assistance. The regulatory chapters that follow describe specific requirements for groundwater users within the AMA. Programs contained in this section include mandatory conservation requirements, a criterion for demonstrating consistency with the management plan by applicants for Certificates of Assured Water Supply, additional programs designed to encourage the use of renewable water sources, recharge program eligibility and operational criteria, criteria for obtaining financial assistance for water management programs, and plan implementation activities, including the Department's compliance and enforcement program.

Chapters 4, 5, and 6 contain the agricultural, municipal, and industrial conservation programs, respectively. Chapter 7 discusses the Department's groundwater quality management program and provides an assessment of water quality within the AMA. Chapter 8 describes the Department's augmentation and recharge program, and Chapter 9 discusses the Department's water management assistance program. Finally, Chapter 10 outlines the Department's policies and procedures for implementation of the Plan.

The regulatory programs are based on a philosophy developed by the Department over the course of the last two management periods. In the first management period, the Department focused on the conservation of groundwater as its primary management goal. In the second management period, the Department continued to enhance the conservation programs, but also implemented a program for the augmentation of water supplies, which included incentives for the increased use of renewable supplies. In the third management period, the Department's focus is on both conservation of groundwater and augmentation of water supplies. The Department's regulatory philosophy is based on its overall water management goals for the management plans: the conservation of groundwater through the efficient use of all water sources and the augmentation of water supplies to ensure a long-term, secure water supply.

The safe-yield goal and the overall mission statement of the Department are guiding concepts in the agency's activities. An understanding of the basic framework of the regulatory programs requires knowledge of the components of the safe-yield goal and the Department's compliance approach. The framework is described below.

- **The AMA Management Goal: Safe-yield**

"Safe-yield" by January 1, 2025 is the management goal of the Tucson AMA. "Safe-yield" is defined by statute to mean:

[A] groundwater management goal which attempts to achieve and thereafter maintain a long-term balance between the annual amount of groundwater withdrawn in an active management area and the annual amount of natural and artificial recharge in the active management area. A.R.S. § 45-561 (12).

The statute specifies that safe-yield is “a long-term balance.” Thus, the hydrologic conditions in the AMA cannot simply be viewed in the short-term, but rather must be viewed over a longer period of time. Further, establishing a “balance” is more complicated than comparing the total amount of groundwater withdrawals for the AMA to the amount of recharge occurring in the area in a given year.

In analyzing whether an AMA is at a safe-yield condition, the Department considers the following factors which impact groundwater levels and water in storage:

1. Net natural recharge: Net natural recharge in a given year is the volume of water that naturally recharges the groundwater supply minus the natural depletions to the groundwater supply over the course of that year. The components of net natural recharge that increase the groundwater supply are stream channel infiltration, mountain front recharge, and groundwater inflow into the AMA. The components that naturally deplete the groundwater supply are groundwater outflow out of the AMA and water loss due to evapotranspiration. Infiltration of treated effluent discharged to surface water channels is not a component of net natural recharge.
2. Incidental recharge: Incidental recharge originates as groundwater or surface water which percolates down to the water table during and after its use for human activity. In the Tucson AMA, the volume of incidental recharge is largely dependent on the quantity of municipal effluent discharged into stream channels, and the volume and efficiency of agricultural and mining water use. It should be noted that incidental recharge that occurs during the use of the water may not be permitted as an underground storage activity under the state’s Underground Water Storage (UWS) Program. Water that is treated after its use for municipal purposes, becomes effluent, and is released into a natural streambed, however, is specifically recognized by the UWS Program as eligible to become a managed underground storage activity. *See A.R.S. §§ 45-801.01 et seq.* As is more fully explained below, storage credits that are accrued through an effluent discharge that has been permitted as a managed storage facility cannot be counted as a contribution to safe-yield.
3. Artificial recharge: Under the state’s UWS Program, A.R.S. §§ 45-801.01 *et seq.*, persons may undertake recharge projects to purposely add water to an aquifer without the right to withdraw it in the future. However, artificial recharge is commonly used as a storage mechanism to accrue credits with the expectation of future recovery. Stored water for which credits have been issued cannot be counted as a contribution to safe-yield, because it is already allocated to the water storer. Therefore, this type of water has no impact on the safe-yield volume; however, it does result in a temporary increase in groundwater in storage.

Not all water stored under the UWS Program can be recovered. The volume of recharge which is allocated permanently to the aquifer, or the “cut to the aquifer” that results from generation of certain types of recharge credits does benefit the aquifer and is a component of the safe-yield groundwater supply. In addition, any non-recoverable storage that is conducted under the UWS Program in a given year can be included in the safe-yield volume for that year. Recharge credits that are generated and then subsequently extinguished prior to use are also a component of the safe-yield supply.

4. Groundwater pumping: Annual pumpage volumes from the AMA’s aquifers are considered in the safe-yield calculation. Withdrawals in association with irrigation grandfathered rights, non-irrigation grandfathered rights, groundwater withdrawal permits, and undesignated municipal providers are calculated as debits to the groundwater system.

Also considered in the safe-yield calculation as a debit to the system is the volume of groundwater allowed through the Assured Water Supply Program for each Designation and Certificate of Assured Water Supply issued prior to 2025. The Department concluded in the development of the Assured Water Supply Rules that a limited quantity of the groundwater in storage could be allocated as a portion of the allowable water supply for each applicant. This groundwater can be used at any time in the 100 year period; however, it is expected that this allowance will be used in the early years while other supplies are being developed, or to offset groundwater pumpage during shortage years in CAP supplies.

5. Committed demand: Committed demand is an important component in the calculation of safe-yield. In the context of an application for a Designation of Assured Water Supply, the applicant must demonstrate the physical availability of a water supply for a 100 year period which includes sufficient water to serve current, committed, and projected demand. Committed demand is associated with platted, undeveloped lots which will be served in the future. In the assured water supply demonstration process, all demands, including the committed demand, must be determined to be physically available. This demand is reflected in the safe-yield calculation. Outside of the designation process, committed demand is associated with unbuilt subdivisions for which a Certificate of Assured Water Supply already exists. In addition, lots that otherwise fall outside of the Assured Water Supply Program requirements represent a potential future demand. This committed groundwater demand must be counted as already having been “allocated” when examining safe-yield. To do otherwise would allow groundwater to be allocated multiple times to multiple developments, resulting in an underestimation of the long-term demands on the AMA’s aquifers.

The volume of groundwater that can be withdrawn while maintaining a safe-yield condition in the AMA is not a fixed amount; it will change due to annual variations in incidental, natural, and artificial recharge, as well as other factors listed above. The groundwater system is in a state of “overdraft” as long as groundwater withdrawals exceed the sum of the naturally and incidentally recharged volumes plus the portion of the artificially recharged volume that will not be withdrawn later as storage credits.

Because water level changes are direct indicators of changes in groundwater storage, they are the measured data which support the other factors of the safe-yield analysis. However, changes in water levels are expected to continue even after achievement of safe-yield, as stored credits are recovered and entities with assured water supply designations utilize their groundwater allotments. An AMA that is at safe-yield should not experience broad-ranging, significant, and continuing declines in average water levels after adjustments are made for the factors just described. Therefore, water levels are considered in making the safe-yield determination.

- **Total Water Use Conservation Requirements and “Stacking”**

With the wide array of water resources available in Arizona as an alternative to groundwater, including surface water, effluent, CAP water, and poor quality remediation water, the Department attempts to provide incentives that will promote use of these alternative supplies whenever and wherever possible. At the same time, we recognize that groundwater is often a very accessible and inexpensive source of supply, whereas the alternative sources can be expensive and difficult to use. The Department also recognizes that groundwater is our state’s “emergency” supply, and it must be available for use whenever the other alternatives run short. Groundwater is particularly valuable as a long-term drought supply, to buffer the effect of changes in surface water availability. In order to maximize the supply of groundwater, and ensure sufficient supplies of

water, all sources must be utilized efficiently.

For these reasons, the Department believes that it is both impractical and unwise to consider groundwater use as the only measure of regulatory compliance. The level of groundwater use that is reasonable is relative to the amount of water used from other sources. To ensure that groundwater users make reasonable use of groundwater, and to encourage efficiency and flexibility in the use of alternative supplies, the regulatory strategy includes evaluation of the total water use of each water user and provider, and setting conservation requirements based upon that total water use. In keeping with the Department's statutory obligations and limitations, however, the conservation requirements of the management plan only apply if groundwater is used.

The Department's regulatory program is, therefore, structured around the concept of "stacking" different types of water, by type, in a compliance hierarchy, with groundwater on top. If a total water use conservation requirement is exceeded by a user of groundwater, the amount of the violation of that requirement will be measured by the amount of groundwater used in excess of the regulatory requirements. This strategy will ensure that if groundwater is being used, it is being used as wisely and efficiently as economically possible. This system also provides the flexibility needed by most users of commingled supplies, allowing groundwater to be used as needed to supplement alternative sources

- **Flexibility in the Components of the Regulatory Plan**

The Department recognizes that water use varies by year and locality. Therefore, the Department has provided maximum flexibility when administering the regulatory provisions of the management plan. For example, most regulatory provisions include a basic program, with one or more alternative programs designed to meet special circumstances. The basic program is generally designed to place simple numerical limits on water use, leaving the means of achieving those limits wholly up to the water user or provider. The alternative programs tend to remove numerical limits in favor of specific conservation measures more suitable to the water user.

Another component of regulatory flexibility is the establishment of "flexibility accounts" for most allotment-based requirements. These accounts generally allow water users to borrow or bank water from one year to the next in order to overcome the variation in use caused by weather or other unforeseen circumstances. Flexibility accounts are mandated by statute for agricultural users, and the Department has used this example to incorporate flexibility accounting into municipal and industrial programs as well.

- **Administrative Review and Variance of Conservation Requirements**

Even with the general flexibility of the regulatory programs, the Groundwater Code (Code) recognizes that certain individual conservation requirements may pose hardship in certain circumstances. To allow relief in these situations, the Code provides for an administrative review and variance process. The emphasis in this process is on the impact of a particular conservation requirement as it is applied to an individual water user. Administrative review and variance are fact-intensive inquiries which may result in some regulatory relief and are considered on a case-by-case basis.

- **Accounting for Water Use**

Many water providers deliver a mix of water types. In order to determine compliance with conservation requirements, the Department must adopt a set of policies for commingled systems. The Department is continuing to develop policies for "volumetric" accounting.

Generally, a water provider delivering different types of water through a commingled system cannot determine which type of water a customer actually received. Therefore, the provider is generally asked to account for all deliveries to its customers on a volumetric as opposed to molecular basis. This allows the provider to compute the percentage of each type of water delivered in a given year, and apply that same percentage to the water delivered to each customer, regardless of the type of water actually received by the customer. This volumetric accounting policy works well for most providers, because of its simplicity and certainty. Individual circumstances may warrant individual consideration, however, and the Department is constantly reviewing its policies on volumetric accounting to recognize necessary exceptions. Generally speaking, however, the Department does not recognize accounting which shows a concentration of deliveries of certain types of water to certain users if the delivery system is physically commingled.

- **Enforcement**

An effective conservation plan requires effective enforcement. The Department is given wide ranging enforcement authority in the statutes to ensure that all water users are contributing their share to the overall goal of groundwater conservation and augmentation of water supplies. While the statutes allow the imposition of substantial monetary penalties for violating either water use limitations or conservation requirements, the Department is also given considerable discretion in how that enforcement program will be managed. Overall, the Department's philosophy has been that the ability to correct management deficiencies and save groundwater is more important than collecting monetary penalties. Therefore, most of the Department's regulatory efforts to date have involved voluntary "consent orders" where the water user in violation agrees to adopt conservation measures, guarantee future compliance, or otherwise mitigate the impact of the violation on the state's groundwater resources in exchange for waiver or reduction of the civil penalties. This approach has worked well in the past, and has been particularly useful in making the transition from a state where groundwater use was essentially unregulated to a state where water regulation has become a fact of everyday life.

In the third management period, the Department will continue its policy of reviewing each suspected violation on an individual basis. The Department will also continue its policy of working with any water user in violation of the groundwater laws to make certain that all the surrounding circumstances are understood and to explore alternative means by which the problem might be solved. In some cases, however, violations are not matters of inadvertence or misunderstanding, but are repeat offenses or voluntary decisions based on economic considerations, lack of planning, or careless disregard for the resource. During the third management period, the Department will strive to identify these latter types of violations and pursue stringent civil penalties. By so doing, the Department intends to bring greater equity and fairness to the common goal of saving our groundwater supply. Alternative mechanisms to achieve compliance while encouraging achievement of local water management goals will also be explored.

The foregoing synopsis of the Department's regulatory approach is intended to assist the reader in understanding the reasons behind the mandatory conservation requirements in the following regulatory chapters. In addition, we have included a Plan Implementation Chapter which gives more definitive explanation to many of the administrative policies and procedures introduced here. Finally, it has always been the Department's policy to offer assistance to anyone seeking to better understand or comply with the conservation requirements imposed by the management plans, or the requirements of the Groundwater Code. The AMA offices, or the central office in Phoenix, can provide valuable support on most water management issues.

*Agricultural Conservation Program*



## **4.1 INTRODUCTION**

The Agricultural Conservation Program for the Third Management Plan has been developed to contribute to the achievement of the safe-yield goal by the year 2025 for the Tucson Active Management Area (AMA). The agricultural sector's contribution to meeting the Tucson AMA's safe-yield goal is projected to come from a combination of improved on-farm water management practices, utilization of renewable supplies, and the reduction of irrigated acreage due to urban and industrial development.

As discussed in Chapter 3, agriculture is responsible for about one-third of the total annual water use in the Tucson AMA. In 1995, approximately 94,000 acre-feet of water were used for agricultural irrigation purposes. Most of this water came from groundwater sources. Other sources of water used for agricultural irrigation include treated effluent and Central Arizona Project (CAP) water through the Arizona Department of Water Resources' (Department) Groundwater Savings Program.

Under the Groundwater Code (Code), only land associated with a Certificate of Irrigation Grandfathered Right (IGFR) can be legally irrigated with groundwater within an AMA. A.R.S. § 45-465. These certificates were issued by the Department based on crops and acreage planted from the years 1975 to 1980. Land not irrigated during this time period may not be irrigated with any water unless one of the exceptions stated in the Code applies. A.R.S. § 45-452. For each IGFR, the Department establishes a maximum annual groundwater allotment based on certain statutory criteria.

At this time, the Department is deferring adoption of a Base Program under A.R.S. § 45-566(A)(1) as part of the Agricultural Conservation Program. This delay is based on concerns which have been raised by the agricultural community regarding the proposed adoption of an agricultural conservation program that includes water duties based upon an 85 percent irrigation efficiency.

Presently, the Department is adopting the Historic Cropping Program that was authorized by A.R.S. § 45-566.02 and conservation requirements for irrigation distribution systems. Participation in the Historic Cropping Program is voluntary, and those who do not participate will be subject to the agricultural conservation requirements established by the Second Management Plan until the Department adopts a Base Program for the Third Management Plan. Descriptions of the Historic Cropping Program and the irrigation distribution system conservation program are detailed in this chapter.

In addition to these regulatory conservation programs, the Department will continue to encourage the efficient use of renewable water supplies by the agricultural sector through other water resource management methods. During the third management period, indirect recharge at groundwater savings facilities, effluent reuse programs, and water management assistance program funds will contribute to the water management activities in the Tucson AMA.

In this chapter, the following topics are discussed in the order listed:

- Statutory Provisions
- Irrigation Water Duties and Maximum Annual Groundwater Allotments
- Agricultural Conservation Program Components
- Non-regulatory Water Resource Management Strategies
- Future Directions
- Agricultural Conservation Requirements and Monitoring and Reporting Requirements



## **4.2 STATUTORY PROVISIONS**

The Code limits uses of groundwater for irrigation purposes in AMAs in several ways. These statutory provisions are described below.

### **4.2.1 Third Management Plan**

A.R.S. § 45-566 requires the director to follow established guidelines in developing management plans for the third management period (the years 2000 to 2010). For the agricultural sector, in the plan for each AMA, the director:

- Shall establish an irrigation water duty for each farm unit to be reached by the end of the third management period.
- May establish one or more intermediate water duties to be reached at specified intervals during the third management period.
- Shall calculate the irrigation water duty or intermediate water duties as the quantity of water reasonably required to irrigate the crops historically grown in the farm unit and shall assume the maximum conservation consistent with prudent long-term farm management practices within areas of similar farming conditions, considering the time to amortize conservation investments and financing costs.
- After computing the irrigation water duties or intermediate water duties, may adjust the highest 25 percent of the water duties within an area of similar farming conditions by reducing each water duty in an amount up to 10 percent, except that in making the adjustment, no water duty may be reduced to an amount less than the highest water duty within the lowest 75 percent of the water duties computed within an area of similar farming conditions.
- Shall grant an exemption from the irrigation water duties at any time during the third management period if an applicant can demonstrate to the director's satisfaction that the applicant's farm unit meets specific hydrologic conditions regarding waterlogging or basin outflow.
- Shall establish additional economically reasonable conservation requirements for the distribution of groundwater by cities, towns, private water companies, and irrigation districts within their service areas.

### **4.2.2 New Irrigated Lands Prohibited**

Under A.R.S. § 45-452, only acres of land which were legally irrigated at any time from January 1, 1975 through January 1, 1980, which are capable of being irrigated, and which have not been retired from irrigation or conveyed for a non-irrigation use, may be irrigated with any water unless one of the following exceptions apply:

- Surface water may be used pursuant to decreed or appropriative rights established before June 12, 1980. A.R.S. § 45-452(A).
- Existing acreage irrigated with surface water may be replaced with new acreage if the surface water right is severed and transferred to the new acreage. A.R.S. § 45-172.
- State universities may irrigate new acreage not to exceed a total of 320 acres of land with not more than five acre-feet of groundwater per acre per year. A.R.S. § 45-452(I).

- Correctional facilities under the jurisdiction of the Arizona Department of Corrections may irrigate new acreage not to exceed a total of 10 acres of land with not more than four and one-half acre-feet of water per acre per year for the purpose of producing plants for consumption by inmates as part of a prisoner work program. A.R.S. § 45-452(J).
- Existing acreage damaged by floodwaters may be replaced with new acreage. A.R.S. § 45-465.01.
- Existing acreage which has a condition that limits irrigation efficiency may be replaced with new acreage. A.R.S. § 45-465.02.

#### **4.2.3 Maximum Annual Groundwater Allotments**

Under A.R.S. § 45-465, the maximum annual groundwater allotment for each IGFR is determined by multiplying the irrigation water duty by the water duty acres. The irrigation water duty is the annual amount of water in acre-feet per acre that is reasonable to apply to irrigated land to produce the crops historically grown (1975 to 1980) divided by an assigned irrigation efficiency. Water duty acres are the highest number of acres in a farm, taking land rotation into account, that were legally irrigated during any one year from 1975 to 1980. The maximum annual groundwater allotment may be used to irrigate any or all of the irrigation acres in the farm unit. Irrigation acres are the acres in the farm which were legally irrigated at any time from 1975 to 1980.

#### **4.2.4 Flexibility Account Provisions**

In order to provide farmers with sufficient flexibility to address varying climatic conditions and to take advantage of changing agricultural market conditions, the Code requires the director to establish a flexibility (flex) account for each farm which receives a maximum annual groundwater allotment. A.R.S. § 45-467. In 1987, the Department began implementing these provisions in the Tucson AMA.

Under the flex account statute, a right holder may accumulate both flex account credits and debits. If a right holder uses water during a year in excess of the farm's maximum annual groundwater allotment, the flex account is debited. A negative balance which exceeds 50 percent of the annual allotment, results in a violation of the conservation requirement. If a right holder uses less water during a year than the farm's maximum annual groundwater allotment, the flex account is credited. Accrued flex account credits are not limited, can be used at any time in future years, and may be used to offset a debit. In addition, under certain conditions right holders may transfer the flex account credits accumulated during the preceding calendar year from one IGFR to another. A.R.S. § 45-467(O).

#### **4.2.5 Historic Cropping Program**

In 1998, the legislature adopted A.R.S. § 45-566.02 that directs the Department to include in the Third Management Plan an agricultural conservation program entitled the Historic Cropping Program. Laws 1998, Ch. 274, § 1. Under this program, the director must calculate the maximum annual groundwater allotment as provided in A.R.S. § 45-465 and must calculate the irrigation water duty using an irrigation efficiency of 75 percent. In areas deemed by the director to have limiting soils, the statute authorizes the director to use an irrigation efficiency as low as 70 percent. In addition, the director may not register credits to the flex account established under A.R.S. § 45-467 which cause the credit balance to exceed 75 percent of the maximum annual groundwater allotment established under the Historic Cropping Program. This program is described in more detail in section 4.4.1.

#### **4.2.6 Small Irrigation Grandfathered Rights**

In 1994, legislation was passed that deregulated small IGFRs. A small IGFR is defined as an irrigation grandfathered right appurtenant to a farm with ten or fewer irrigation acres, and that is not part of an integrated farming operation of more than ten acres. Under A.R.S. §§ 45-563.02 and 632(D), small IGFRs are not required to report annual water use or to comply with water duty limitations. Small IGFRs make up about one half of the IGFRs in the Tucson AMA. Based on reporting data submitted to the Department prior to 1994, agricultural water use on these small rights accounted for approximately one percent of the total annual irrigation water use.

### **4.3 IRRIGATION WATER DUTIES AND MAXIMUM ANNUAL GROUNDWATER ALLOTMENTS**

The irrigation water duty is the primary component of the Historic Cropping Program and is used to determine the maximum annual groundwater allotment for each IGFR. The following sections describe how the Department determines water duties and maximum annual groundwater allotments.

#### **4.3.1 Calculation of Irrigation Water Duties**

The irrigation water duty is the quantity of water reasonably required per acre to annually irrigate the crops historically grown in a farm unit from 1975 to 1980. The crops historically grown in each farm unit were verified and established during the first management period. The Department calculates the irrigation water duty for each IGFR using the following formula:

$$\text{Irrigation Water Duty} = \frac{\text{Total Irrigation Requirement Per Acre}}{\text{Assigned Irrigation Efficiency}}$$

In this formula, the irrigation water duty is calculated by dividing the total water requirements to produce the crops historically grown by an assigned irrigation efficiency. Each component of the formula is discussed below.

##### **4.3.1.1 Assigned Irrigation Efficiencies**

Irrigation efficiency is a measure of the overall effectiveness of water application during a crop season. The effectiveness is a function of many variables including evaporation loss, soil intake rate, water application rates, irrigation system type, crop type, and irrigation water management practices.

The assigned irrigation efficiency establishes a benchmark value which is determined for each management period in accordance with statutory provisions. For the Historic Cropping Program, the assigned irrigation efficiency for farms with non-limiting soils is 75 percent as prescribed by A.R.S. § 45-566.02.

##### **4.3.1.2 Total Irrigation Requirement**

The total irrigation requirement for each farm unit equals the amount of water needed annually to satisfy the sum of the irrigation requirements for all of the crops historically grown. For each crop, the irrigation requirement (IR) consists of the amount of water needed to meet: the consumptive use (CU) requirement of the crop, plus any other needs (ON) that the crop may have, plus any needed leaching allowance (LA), less the amount of any effective precipitation (EP). The total irrigation requirement is calculated by the following equation:

$$IR = CU + ON + LA - EP$$

The components of the total irrigation requirement equation are discussed below.

#### 4.3.1.2.1 Consumptive Use

The consumptive use requirement of a crop is the amount of water used in transpiration and building of plant tissue, together with the amount of water evaporated from adjacent soil during the growing season. Crop consumptive use values are based on accepted scientific methods and commonly used values for the Tucson AMA. Appendix 4 lists the consumptive use requirement for each crop historically grown in the Tucson AMA during the years 1975 to 1980 based upon data currently available.

#### 4.3.1.2.2 Other Needs

Water required by certain crops for purposes other than consumptive use is referred to as “other needs” water. Some vegetable crops, such as lettuce, need additional water for germination, cooling, and quality control. The Department makes adjustments for those crops which have “other needs.” Appendix 4 lists the “other needs” requirements for crops historically grown in the Tucson AMA.

#### 4.3.1.2.3 Leaching Allowance

In some situations, a crop may require additional water for leaching or deep percolation. A leaching allowance may be necessary to prevent salts from accumulating in the crop root zone when high levels of total dissolved solids (TDS) are present in the irrigation water. If the accumulated salts in the soil profile are not leached below the root zone, soil salinity will increase and eventually inhibit plant growth and yields.

The procedure used to calculate the leaching allowance for a crop is shown by the following equation:

$$LA = \frac{AE}{0.85} \left[ CU \left[ \frac{1}{1 - \frac{EC_w}{5EC_e - EC_w}} - 1 \right] \right]$$

In this equation, LA = leaching allowance for the crop; AE = assigned irrigation efficiency for the farm unit; CU = consumptive use requirement of the crop;  $EC_w$  = electrical conductivity of the irrigation water (expressed in millimhos per centimeter); and  $EC_e$  = tolerance of the crop to soil salinity as indicated by the electrical conductivity of the soil saturation extract (expressed in millimhos per centimeter).

Most irrigation water in the Tucson AMA is of adequate quality for irrigation purposes. Consequently, the Department did not include any leaching allowances in the calculation of irrigation requirements for crops grown in the Tucson AMA. If, however, a particular irrigation water supply has an  $EC_w$  value greater than 1.5 millimhos per centimeter (a concentration of approximately 1,000 milligrams per liter of TDS), the right holder may apply to the Department for an administrative review as discussed in Chapter 10.

#### 4.3.1.2.4 Effective Precipitation

Effective precipitation is defined as the amount of precipitation occurring before and during the growing season that is available for plant growth. Because precipitation is minimal and varies considerably by year and location in the Tucson AMA, effective precipitation is difficult to quantify and is not subtracted from

the total irrigation requirements for the crops historically grown. However, managing the use of precipitation to offset use of other water supplies could be an important irrigation water management tool.

#### **4.3.2 Calculation of Maximum Annual Groundwater Allotments**

The maximum annual groundwater allotment for each IGFR is determined by multiplying the irrigation water duty by the water duty acres. These calculations are governed by A.R.S. § 45-465 (see section 4.2.3).

#### **4.4 AGRICULTURAL CONSERVATION PROGRAM COMPONENTS**

The following section describes the Agricultural Conservation Program for the Third Management Plan that is being adopted at this time. This program consists of two main parts: the Historic Cropping Program and the irrigation distribution system conservation requirements program. Each of these programs is described below.

##### **4.4.1 Historic Cropping Program**

The Historic Cropping Program was developed by the Department pursuant to A.R.S. § 45-566.02. As required by this statute, for the Historic Cropping Program, the Department will calculate the water duty and maximum annual groundwater allotment by dividing the total irrigation requirement per acre by an assigned irrigation efficiency of 75 percent. In areas determined by the director to have limiting soils, the director may use an assigned irrigation efficiency as low as 70 percent for the water duty calculation. As further required by A.R.S. § 45-566.02, the use of flex account provisions will be limited.

In order to qualify for the Historic Cropping Program, the IGFR owner must satisfy the following requirements: (1) file an application with the Department, (2) reduce any debit balance in the existing flex account to an amount which does not exceed 25 percent of the existing maximum annual groundwater allotment, (3) reduce any flex account credits in the existing flex account balance to an amount which does not exceed 75 percent of the existing maximum annual groundwater allotment, and (4) provide documentation showing that an actual irrigation efficiency of 75 percent has been, or will be, achieved on the farm on a seasonal basis. Once an IGFR owner has been accepted into the Historic Cropping Program, the right holder must remain in the Historic Cropping Program during the entire third management period, unless there is a change in IGFR ownership.

Participants in the Historic Cropping Program will be subject to limitations on their ability to accumulate flex account credits and debits. Right holders will only be allowed to accrue flex account credits up to 75 percent, and flex account debits up to 25 percent, of their maximum annual groundwater allotment calculated for the Historic Cropping Program. Any IGFR owner, or any person entitled to use groundwater pursuant to that IGFR, who uses groundwater in an amount which causes the farm's flex account to be in arrears in excess of 25 percent of the maximum annual groundwater allotment will be considered in violation of the conservation requirement. In addition, participants in the Historic Cropping Program will not be allowed to sell or purchase flex account credits.

In addition to these flex account credit provisions, participants will also be required to comply with certain reporting requirements. Participants must provide information regarding irrigation water management practices, irrigation system type, and the acreage and type of crops grown to assist the Department in determining program effectiveness.

The Historic Cropping Program requires a high level of farm management. Specific entrance and performance criteria must be satisfied, and only owners of IGFRs may apply (see section 4.7). IGFR

owners interested in participating in the Historic Cropping Program may file an application beginning January 1, 2000 on forms provided by the Department.

#### **4.4.2 Irrigation Distribution System Conservation Program**

For the third management period, the director is required to establish “additional economically reasonable conservation requirements for the distribution of groundwater by cities, towns, private water companies and irrigation districts within their service areas.” A.R.S. § 45-566(A)(5). The same conservation requirements were part of the Second Management Plan. A.R.S. § 45-565(A)(5).

In the Second Management Plan, private water companies and irrigation districts which distributed 20 percent or more of their total water deliveries for irrigation use by January 1, 1990, were required to reduce their irrigation distribution system lost and unaccounted for water either by lining all their canals, or by operating their delivery systems so that the total quantity of lost and unaccounted for water is 10 percent or less of the total quantity of water withdrawn, diverted, or received during a year. These requirements become effective upon commencement of operation or by January 1, 2000, whichever is later. A Department review of the conservation practices of the largest irrigation districts located within AMAs has shown that the Second Management Plan distribution system conservation requirements are being achieved by most districts.

For the Third Management Plan, the irrigation distribution system conservation requirements established by the Second Management Plan will continue to apply to irrigation districts and private water companies which, as of January 1, 2000, distribute 20 percent or more of their total water deliveries for irrigation use. These irrigation districts and private water companies will be required to reduce their irrigation distribution system lost and unaccounted for water either by lining all their canals, or by operating their delivery systems so that the total quantity of lost and unaccounted for water is 10 percent or less of the total quantity of water withdrawn, diverted, or received during a year. These requirements become effective upon the commencement of operation or by January 1, 2002, whichever is later. Until this time, the Second Management Plan irrigation distribution system conservation requirements will apply.

If a private water company or irrigation district has economic circumstances which prevent timely compliance with the irrigation distribution system conservation requirements, a variance of up to five years may be requested as provided by A.R.S. § 45-574. Information submitted in support of the variance request must include a complete water loss reduction plan, prepared by a registered civil engineer, which contains:

- A complete construction design document which shows specifications for repairing or modifying the irrigation distribution system. The document must include material specifications, proposed design specifications, installation and construction specifications, and any other engineering information or specifications necessary to complete the proposed rehabilitation of the distribution system.
- A detailed list of engineering costs and the proposed investment options designed to pay for the system improvements.
- The final completion date for the rehabilitation.
- If applicable, a system operating guide to reduce lost and unaccounted for water to a minimum. This guide may be modified as the rehabilitation progresses.

The procedures for obtaining a variance are described in Chapter 10, section 10.3.1.

#### **4.4.3 Program Summary**

The Department is adopting an Agricultural Conservation Program for the Third Management Plan that consists of two parts, the Historic Cropping Program and the irrigation distribution system conservation program, each of which is designed to assist in achieving the water resource management goal for the Tucson AMA. The Historic Cropping Program is a new program which the legislature authorized in 1998 through the enactment of A.R.S. § 45-566.02. Pursuant to this legislation, the irrigation efficiency used to calculate the maximum annual groundwater allotment for non-limiting soils is set at 75 percent and the flexibility account provisions of A.R.S. § 45-467 are restricted. The irrigation distribution system conservation requirements are essentially a continuation of requirements that were established for the Second Management Plan. These requirements are designed to assure that the amount of lost and unaccounted for water from water distribution systems is kept to a minimum. Both the Historic Cropping Program and the irrigation distribution system conservation program provide important tools for achieving the water management goal for the Tucson AMA. To further the attainment of this water management goal, the Department will also adopt a Base Program pursuant to A.R.S. § 45-566(A)(1) in the future.

#### **4.5 NON-REGULATORY WATER RESOURCE MANAGEMENT STRATEGIES**

In addition to the Agricultural Conservation Program, there are other water resource management options which are available to achieve the water management goal for the Tucson AMA. These options are described below.

##### **4.5.1 Effluent**

In 1991, the Legislature amended A.R.S. § 45-467 to exclude effluent from consideration in determining the amount of any debit to be registered to a farm's flex account. Laws 1991, Ch. 112, § 3. Under this amendment, a person using groundwater on a farm pursuant to an IGFR may use an unlimited amount of effluent on the farm without any debit being registered to the farm's flex account as a result of effluent use. This amendment created an incentive for the use of effluent.

During the Third Management Plan, the Department will study alternative ways to increase the use of effluent. In the past, effluent utilization for agricultural irrigation has been limited primarily by the lack of necessary infrastructure. Other requirements, such as the wastewater reuse rules adopted by the Arizona Department of Environmental Quality, have limited the types of crops which can be irrigated solely by effluent. As effluent treatment techniques improve and more effluent becomes accessible to the agricultural sector, the Department expects that effluent use for agricultural purposes will increase.

##### **4.5.2 Groundwater Savings Program (Indirect Recharge)**

A reduction in agricultural groundwater use has occurred in the Tucson AMA as a result of indirect recharge opportunities first authorized by the Legislature in 1990 and later reauthorized in 1994 as the groundwater savings program. Laws 1994, Ch. 291, § 32; Laws 1990, Ch. 176, § 14. Historically, agricultural water use in the Tucson AMA had been supplied primarily from groundwater resources. In the early 1990s, the agricultural sector began to utilize CAP water through the incentives provided by the groundwater savings program and arrangements made with non-agricultural water providers. This increased use of renewable water supplies has decreased groundwater use by the agricultural sector in the Tucson AMA.

##### **4.5.3 Conservation Assistance Program**

Non-regulatory efforts such as the Conservation Assistance Program have contributed to the reduction of agricultural water use in the Tucson AMA. The Irrigation Conservation Assistance Program (ICAP),

funded primarily by the Conservation Assistance Program, is currently in its fourth year of operation. The ICAP is a cooperative program with the Department, the Pima Natural Resources Conservation District, the USDA Natural Resources Conservation Service (NRCS), and more recently the United States Bureau of Reclamation (USBR). The ICAP provides irrigation scheduling and water application rate information to participating farmers in the Tucson AMA. A computer program which integrates crop type, field and soil conditions, and weather conditions is used by ICAP to assist farmers in the conservation of water.

Conservation Assistance Program funds were also used to produce a video entitled "Saving Water in Agriculture, Surface Irrigation." The production of this video was made possible through a cooperative effort between the Department, USBR, NRCS, and a private consultant. This video and accompanying manual is intended to educate farm managers and irrigators about efficient on-farm irrigation water management techniques.

Additional Conservation Assistance Program funds were made available to evaluate the utilization of treated effluent on farms in the Tucson AMA. Effluent is a renewable water supply which has the potential to significantly reduce the amount of groundwater used by agriculture.

The use of Conservation Assistance Program monies to fund programs designed to assist the agricultural sector in the conservation of groundwater resources is expected to extend into the third management period. The Department will continue to encourage programs which promote efficient agricultural water use. The Conservation Assistance Program is described more fully in Chapter 9.

#### **4.6 FUTURE DIRECTIONS**

To achieve the goal of safe-yield in the Tucson AMA, reductions in agricultural groundwater use need to continue. The increased utilization of renewable water supplies to replace groundwater use, combined with demand reduction efforts to enhance on-farm irrigation water management practices, are key factors in meeting this water resource management goal.

During the third management period, the Department will continue to provide the agricultural sector with technical and conservation planning assistance to reduce its reliance on groundwater supplies. The Department will investigate incentives for, and encourage, the increased use of effluent and CAP water through groundwater savings projects. In addition, agreements between the USBR and the Tohono O'odham Nation under the Southern Arizona Water Rights Settlement Act may provide alternative water sources to the agricultural sector.

The Department will continue to work cooperatively with the agricultural community to determine appropriate conservation requirements under A.R.S. § 45-566(A)(1), and to develop additional alternative agricultural conservation programs in the Tucson AMA for the third management period.

The Department will continue to support funding for conservation, education, and the use of renewable supplies in order to achieve the water management goal for the Tucson AMA. These monies may be used to assist farmers with irrigation water management practices and for the infrastructure to convey renewable water supplies to farms.

The Department will also continue to monitor crop and water use patterns during the third management period to evaluate agriculture's contribution to achieving the Tucson AMA's safe-yield goal, and the impacts of Department programs on farming operations. Urbanization impacts on agriculture as well as water use trends due to agricultural market conditions will be evaluated for future planning needs.



The Agricultural Conservation Program for the Third Management Plan is a step toward achieving the water resource management goal of safe-yield for the Tucson AMA. During the third management period, this program will continue to be evaluated for its effectiveness in achieving this goal.

## **AGRICULTURAL CONSERVATION REQUIREMENTS AND MONITORING AND REPORTING REQUIREMENTS**

### **4-101. Definitions**

*In addition to the definitions set forth in Chapters 1 and 2 of Title 45 of the Arizona Revised Statutes, the following words and phrases used in sections 4-101 through 4-105 of this chapter shall have the meanings set forth below, unless the context otherwise requires:*

1. *“Assigned Irrigation Efficiency” is defined as the maximum economically feasible levels of conservation within areas of similar farming conditions which each right holder is expected to achieve.*
2. *“Canal” is defined as a waterway constructed for the purpose of transporting water to a point of delivery, including main canals and lateral canals.*
3. *“Farm” is defined under A.R.S. § 45-402.*
4. *“Farm Unit” is defined under A.R.S. § 45-402.*
5. *“Flexibility Account” is an account maintained under A.R.S. § 45-467.*
6. *“Irrigation Acre” is defined under A.R.S. § 45-402.*
7. *“Irrigation Distribution System” is defined as a system of canals, flumes, pipes, or other works which are owned or operated by an irrigation district or private water company and used to deliver water for irrigation use.*
8. *“Irrigation Water Duty” is defined under A.R.S. § 45-566 which, for the Third Management Plan, is the total irrigation requirement to produce the crops historically grown divided by the assigned irrigation efficiency.*
9. *“Lost Water” is defined as water from any source, including effluent, which enters an irrigation distribution system and is lost from the system during transportation or distribution due to seepage, evaporation, leaks, breaks, phreatophyte use, or other causes.*
10. *“Maximum Annual Groundwater Allotment” is defined as the maximum amount of groundwater which may be used per year for the irrigation of each irrigation acre in the farm which is calculated pursuant to A.R.S. § 45-465.*
11. *“On-farm Seasonal Irrigation Efficiency” is defined as the total water requirements to produce a crop divided by the total quantity of water actually applied to that crop during one growing season.*
12. *“Total Quantity of Lost and Unaccounted for Water” is defined as the total quantity of water from any source, including effluent, withdrawn, diverted, or received by an irrigation district or private water company during a calendar year less the total deliveries of water from any source, including effluent, made by the irrigation district or private water company during the calendar year that are measured or estimated based on a generally accepted method of estimating water use.*
13. *“Water Duty Acres” is defined under A.R.S. § 45-461.*

#### **4-102. Base Agricultural Conservation Program Requirements**

*Unless the owner of a Certificate of Irrigation Grandfathered Right (IGFR) is regulated under the Historic Cropping Program described in section 4-103, the IGFR owner and any person who is entitled to use groundwater pursuant to that IGFR shall continue to comply with the agricultural conservation requirements established by the Second Management Plan until the director adopts a Base Program for the Third Management Plan.*

#### **4-103. Historic Cropping Program**

##### **A. Application for Regulation under the Historic Cropping Program**

*Only an owner of an IGFR may apply to be regulated under the Historic Cropping Program. Beginning January 1, 2000, an application may be filed by an IGFR owner at any time prior to the first compliance date for the agricultural conservation requirements established in the Fourth Management Plan. An application for regulation under the Historic Cropping Program shall be on a form prescribed by the director and shall include the following information:*

- 1. The name, address, and phone number of the IGFR owner.*
- 2. The number of the Certificate of Irrigation Grandfathered Right.*
- 3. The name, address, and phone number of any person entitled to use groundwater under the IGFR.*
- 4. For each of the three previous years, the number of acres and types of crops planted and the amount of water used to irrigate the planted acres.*
- 5. For each of the three previous years, the type of irrigation system which has been used, including percent of slope, length of runs, and method of field application.*
- 6. For each of the three previous years, a description of all water conservation practices used on the farm, including the name of any conservation program or irrigation water management service used on the farm.*

##### **B. Criteria for Approval of Application**

*The director shall approve a complete and correct application for regulation under the Historic Cropping Program if the following requirements are satisfied:*

- 1. Any negative flexibility account balance in the farm's flexibility account does not exceed 25 percent of the maximum annual groundwater allotment in effect at the time that the application is made.*
- 2. Any positive flexibility account balance in the farm's flexibility account does not exceed 75 percent of the maximum annual groundwater allotment in effect at the time that the application is made. In order to satisfy this requirement, the IGFR owner may sell or convey any excess credits as provided by A.R.S. § 45-467, or the IGFR owner may relinquish any excess credits.*

3. *The IGFR owner demonstrates that the average on-farm seasonal irrigation efficiency achieved on the farm's irrigation acres during the previous three years was 75 percent or greater. If the IGFR owner cannot demonstrate that an average on-farm seasonal irrigation efficiency of at least 75 percent has been achieved during the previous three years, the IGFR owner shall agree in writing to develop and implement at least one of the following:*
  - a. *Enroll in a Department-sponsored or private irrigation management services program throughout the entire third management period or until the IGFR owner can demonstrate to the Department that an average on-farm seasonal irrigation efficiency of at least 75 percent has been achieved during the previous three years.*
  - b. *Install a conservation system improvement, approved by the Department, designed to enable the IGFR owner to achieve an on-farm seasonal irrigation efficiency of at least 75 percent.*

**C. Historic Cropping Program Requirements**

*An IGFR owner who has been approved for regulation under the Historic Cropping Program and any person using groundwater pursuant to that IGFR shall comply with the provisions of this section.*

1. *The IGFR owner and any person entitled to use groundwater under that IGFR shall comply with the irrigation water duty and maximum annual groundwater allotment established by the director under this section, beginning with the calendar year in which the IGFR owner is accepted into the Historic Cropping Program, and continuing thereafter until the first compliance date for any substitute conservation requirement established in the Fourth Management Plan. The director shall establish the irrigation water duty and maximum annual groundwater allotment in the same manner that the director established the irrigation water duty and maximum annual groundwater allotment assigned to the IGFR in the Second Management Plan, except that the director shall use an assigned irrigation efficiency of 75 percent. In areas deemed by the director to have limiting soils, the director may use an assigned irrigation efficiency as low as 70 percent.*
2. *The IGFR owner, and any person entitled to use groundwater under that IGFR, may use the maximum annual groundwater allotment assigned to the IGFR to irrigate only the irrigation acres to which the IGFR is appurtenant.*
3. *The IGFR owner and any person entitled to use groundwater under that IGFR shall not use water for irrigation purposes during a calendar year in an amount which exceeds the maximum annual groundwater allotment assigned to the right, except as provided in the flexibility account provisions of A.R.S. § 45-467, as modified in subsection D of this section, and any rules adopted by the director.*

**D. Flexibility Account Provisions**

*Under the Historic Cropping Program, the flexibility account provisions of A.R.S. § 45-467 shall apply to the IGFR owner and any person entitled to use groundwater under that IGFR with the following modifications:*

1. *If the amount of water used to irrigate the farm in any year is less than the maximum annual groundwater allotment established for the farm pursuant to subsection C, paragraph 1 of this section, the amount of any credit registered to the farm's flexibility account pursuant to A.R.S. § 45-467 shall not exceed the difference between the existing balance in the account and a positive account balance of 75 percent of the maximum annual groundwater allotment. The director shall not register a credit to the farm's flexibility account in any year in which the account has an existing positive account balance equal to or greater than 75 percent of the maximum annual groundwater allotment.*
2. *The IGFR owner and any person entitled to use groundwater under that IGFR who are regulated under the Historic Cropping Program shall not:*
  - a. *Purchase or sell flexibility account credits to another IGFR owner or any other person entitled to use groundwater under another IGFR regardless of whether they are regulated under the Historic Cropping Program.*
  - b. *Transfer credits from the flexibility account of one farm to another farm even if the farms are owned by the same IGFR owner.*
3. *The maximum excess amount of groundwater that may be used pursuant to A.R.S. § 45-467 shall not exceed 25 percent of the maximum annual groundwater allotment established for the farm pursuant to subsection C, paragraph 1 of this section. The IGFR owner and any person entitled to use groundwater under that IGFR violate this section if the flexibility account maintained for the IGFR is in arrears at any time in excess of this amount.*

**E. Reporting Requirements**

*In addition to the information required to be submitted in the annual report required by A.R.S. § 45-632, the IGFR owner and any person entitled to use groundwater pursuant to that IGFR shall submit the following information in the report:*

1. *The name, address, and phone number of any person entitled to use groundwater under the IGFR.*
2. *The number of acres and types of crops planted and the amount of water used to irrigate the planted acres.*
3. *The type of irrigation system which has been used, including percent of slope, length of runs, and method of field application.*
4. *A description of all water conservation practices used on the farm, including the name of any conservation program or irrigation water management service used on the farm.*

**F. Duration of Regulation under Historic Cropping Program**

1. *Except as provided in paragraph 2 of this subsection, after the director approves an application for regulation under the Historic Cropping Program, the IGFR owner and any person entitled to use groundwater pursuant to that right shall be regulated under the Historic Cropping Program until the first compliance date for any substitute agricultural conservation requirement established in the Fourth Management Plan.*

2. *After the director approves an application for regulation under the Historic Cropping Program, the IGFR owner must remain in the Historic Cropping Program during the entire third management period, except that a subsequent owner of the IGFR may file a written request to leave the Historic Cropping Program with the director within 90 days after acquiring an ownership interest in the IGFR. The director shall grant the request unless the director determines that the request is being made for the purpose of circumventing the provisions of paragraph 1 of this subsection, in which case the request will be denied. In the event that an IGFR is owned by more than one person, this paragraph does not apply unless all owners have conveyed their interests in the IGFR and all subsequent owners join in filing a written request with the director to leave the Historic Cropping Program.*

#### **4-104. Conservation Requirements for Irrigation Distribution Systems**

##### **A. Applicability**

*The irrigation distribution system conservation requirements set forth in subsection B below apply to irrigation districts and private water companies which, as of January 1, 2000, distribute 20 percent or more of their total water deliveries for irrigation use.*

##### **B. Conservation Requirements**

*By January 1, 2002 or upon commencement of operation, whichever is later, and continuing thereafter until the first compliance date of any substitute requirement in the Fourth Management Plan, each irrigation district and private water company owning or operating an irrigation distribution system shall either:*

1. *Line all canals used to deliver water for irrigation use with a material that allows no more lost water than a well-maintained concrete lining, or*
2. *Operate and maintain its distribution system so that the total quantity of lost and unaccounted for water is 10 percent or less of the total quantity of water from any source, including effluent, withdrawn, diverted, or received by the irrigation district or private water company on either a calendar year basis or a three-year average basis based on that calendar year and the two preceding calendar years.*

#### **4-105. Monitoring and Reporting Requirements for Irrigation Districts and Private Water Companies**

##### **A. Applicability**

*The monitoring and reporting requirements set forth in subsection B below apply to irrigation districts and private water companies which, as of January 1, 2000, distribute 20 percent or more of their total water deliveries for irrigation use.*

##### **B. Monitoring and Reporting Requirements**

*For calendar year 2002 and for each calendar year thereafter until the compliance date for any substitute requirement in the Fourth Management Plan, each irrigation district and private water company owning or operating an irrigation distribution system shall submit in its annual report required by A.R.S. § 45-632, the following information as it applies to the irrigation district or private water company:*

1. *A map showing the irrigation distribution system, including those portions which have lined canals and those portions which have unlined canals, unless a current map is on file with the Department.*
2. *The number of miles of lined canals and the number of miles of unlined canals in the irrigation distribution system.*
3. *The total quantity of water from any source, including effluent, which was withdrawn, diverted, or received by the irrigation district or private water company during the calendar year.*
4. *The total quantity of water from any source, including effluent, delivered by the irrigation district or private water company to all water users during the calendar year.*
5. *An estimate of the irrigation district's or private water company's total quantity of lost and unaccounted for water for the calendar year. This quantity shall be determined by a generally accepted engineering method.*

**APPENDIX 4**  
**CONSUMPTIVE USE AND OTHER NEEDS BY CROPS<sup>1</sup>**  
**TUCSON ACTIVE MANAGEMENT AREA**

Crop	Consumptive Use (acre-feet per acre)		Other Needs (acre-feet per acre)
	ASFC <sup>2</sup> 1 - 6	ASFC 7	All ASFCs
<b>Grain Crops</b>			
Barley	1.83	1.83	-----
Corn, Grain	2.67	2.50	-----
Maize (Sorghum)	2.67	2.17	-----
Oats, Grain	1.83	1.83	-----
Rye	1.83	1.83	-----
Sorghum, Grain	2.67	2.17	-----
Wheat	1.83	1.83	-----
<b>Field Crops</b>			
Castor Beans	3.70	3.70	-----
Cotton	3.08	2.58	-----
Peanuts	2.75	-----	-----
Pinto Beans	-----	1.17	-----
Safflower	3.33	-----	-----
Soybeans	1.85	-----	-----
<b>Orchard Crops (Nut)</b>			
Pecans, without Groundcover	4.33	3.58	-----
Pecans, with Groundcover	5.67	-----	-----
Pistachios	4.17	3.50	-----
<b>Forage Crops</b>			
Alfalfa <sup>3</sup>	4.08	3.42	-----
Bermuda Grass	3.50	3.42	-----
Hay, Annual (Non-Alfalfa)	2.25	1.50	-----
Native Pasture	1.75	1.75	-----
Permanent Pasture (Fescue)	5.75	4.67	-----
Sudan Grass	2.25	1.50	-----
<b>Vegetable Crops</b>			
Carrots	1.38	-----	.75
Chili Peppers	-----	2.33	.50
Corn, Sweet	1.63	1.42	.87



**APPENDIX 4**  
**CONSUMPTIVE USE AND OTHER NEEDS BY CROPS<sup>1</sup>**  
**TUCSON ACTIVE MANAGEMENT AREA**

Crop	Consumptive Use (acre-feet per acre)		Other Needs (acre-feet per acre)
	ASFC <sup>2</sup> 1 - 6	ASFC 7	All ASFCs
Lettuce, All	.71	.71	2.44
Onions, Dry	1.94	-----	.75
Tomatoes, All	2.00	-----	.50
Vegetables, Mixed	2.00	-----	.50
<b>Fruit</b>			
Apricots	3.92	3.00	-----
Cantaloupe, Late	-----	1.33	.50
Citrus, All	3.75	-----	-----
Grapes	-----	2.50	.50
Peaches	3.92	-----	-----
Plums	3.92	-----	-----
Watermelons	1.75	-----	.50
<b>Miscellaneous Crops</b>			
Jojoba	3.00	-----	
Christmas Trees	2.50	2.25	
Nursery Stock	3.00	-----	

<sup>1</sup> Based on crops that were reported in the 1975 to 1980 history.

<sup>2</sup> Areas of Similar Farming Conditions (see Chapter 3, section 3.1.3)

<sup>3</sup> Based on the average historical high yield of alfalfa in Pima County of 6.5 tons per acre and a consumptive use (CU) rate of 7.5 acre-inches per acre per ton of production, rounded to the nearest acre-inch. Farm units that demonstrated historic yields above this average were assigned higher CU rates accordingly, not to exceed a high CU value of 5.67 acre-feet per acre. ASFC 7 was based on an average historical high yield for Santa Cruz County of 5.5 tons per acre.

Sources: Consumptive Use of Water by Major Crops in Southwestern United States. Conservation Research Report #29, Agricultural Research Service, USDA, (1982).

FAO Irrigation and Drainage Paper # 24, Food and Agriculture Organization of the United Nations (revised 1977).

**APPENDIX 4**  
**ASSIGNED CONSUMPTIVE USE (CU) VALUES FOR CROPS ASSOCIATED WITH**  
**FARM UNITS TEN ACRES OR LESS**  
**TUCSON ACTIVE MANAGEMENT AREA**

**HIGH CONSUMPTIVE USE CROPS**

Crops with a CU value of 4.30 acre-feet per acre or more in ASFCs<sup>1</sup> 1-6, are assigned a CU value of 5.00 acre-feet per acre. Crops with a CU value of 3.60 acre-feet per acre or more in ASFCs 7 are assigned a CU value of 4.50 acre-feet per acre.

Alfalfa  
Pecans (with and without Groundcover)  
Permanent Pasture (Fescue)  
Pistachios

**MEDIUM CONSUMPTIVE USE CROPS**

Crops with a CU value of 2.25 to 4.30 acre-feet per acre in ASFCs 1-6, are assigned a CU value of 3.25 acre-feet per acre. Crops with a CU value of 2.25 to 3.60 acre-feet per acre in ASFCs 7 are assigned CU value of 3.00 acre-feet per acre.

Apricots	Grapes	Peaches
Bermuda Grass	Guayule	Peanuts
Corn, Grain	Jojoba	Plums
Cotton	Nectarines	Rappini
Citrus, All	Nursery Stock	Safflower
Chili Peppers	Olives	Sorghum (Grain, Double Cropped)
Christmas Trees	Okra	Sugar Beets

**LOW CONSUMPTIVE USE CROPS**

Crops with a CU value less than 2.25 acre-feet per acre in all ASFCs are assigned a CU value of 2.00 acre-feet per acre.

Barley	Cucumbers, All	Mixed Vegetables	Rye
Beets, Table	Ensilage	Native Pasture	Sorghum, Grain
Broccoli	Hay, Annual	Oats, Grain	Sudan Grass
Cabbage, All	(Non-Alfalfa)	Onions, All	Summer Squash
Cantaloupe, All	Lettuce, All	Parsnips	and Zucchini
Carrots	Maize	Pinto Beans	Tomatoes, All
Cauliflower	Melons, All	Potatoes	Turnips and Rutabaga
Corn, Sweet	Miscellaneous Vegetables	Radishes	Wheat

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<sup>1</sup>ASFCs = Area of Similar Farming Conditions (see section 3.2.1)